

Listing of Claims

The below listing of claims will replace all prior versions of claims in the application.

1. (Currently Amended) A cantilever for use in ~~a tapping mode~~ an atomic force microscope, the cantilever comprising:
a cantilever arm having a fixed end and a free end, the cantilever arm having a fundamental resonance frequency and at least one higher order resonance frequency;
and
a probe tip projecting from the cantilever arm near the free end,
wherein the cantilever is to be used in an atomic force microscope and the cantilever arm has a shape selected to tune the fundamental resonance frequency of the fundamental mode or a resonance frequency of a selected higher order mode so that the resonance frequency of the selected higher order mode and the fundamental resonance frequency has an integer ratio.
2. (Original) The cantilever of claim 1, wherein the integer ratio comprises whole numbers and fractional numbers slightly greater than or less than the nearest whole numbers so that when the cantilever is driven at a driving frequency at or slightly below or slightly above the fundamental resonance frequency, the resonance frequency of the selected higher order mode is an integer multiple of the driving frequency.
3. (Original) The cantilever of claim 2, wherein the integer ratio comprises whole numbers and fractional numbers within 2.0% of the nearest whole numbers.
4. (Original) The cantilever of claim 1, wherein the free end of the cantilever arm has a second shape selected to tune the fundamental resonance frequency of the cantilever to a value that is integer divisible of the resonance frequency of the selected higher order mode.
5. (Original) The cantilever of claim 4, wherein the second shape comprises tapered sides forming the free end of the cantilever arm.
6. (Original) The cantilever of claim 1, wherein the cantilever arm comprises a first geometric feature disposed at a predefined location of the cantilever arm, the first geometric feature operating to modify the mass of the cantilever arm at the predefined location to tune the fundamental resonance frequency or the resonance frequency of the

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selected higher order mode of the cantilever so that the fundamental resonance frequency and the resonance frequency of the selected higher order mode has an integer ratio.

7. (Original) The cantilever of claim 6, wherein the first geometric feature operates to reduce the effective width of the cantilever arm at the predefined location.

8. (Original) The cantilever of claim 6, wherein the first geometric feature operates to increase the effective width of the cantilever arm at the predefined location.

9. (Original) The cantilever of claim 6, wherein the first geometric feature operates to reduce the thickness of the cantilever arm at the predefined location.

10. (Original) The cantilever of claim 6, wherein the first geometric feature operates to increase the thickness of the cantilever arm at the predefined location.

11. (Original) The cantilever of claim 6, wherein the first geometric feature is located at a location of high mechanical bending stress for the fundamental mode or the selected higher order mode.

12. (Original) The cantilever of claim 11, wherein the first geometric feature is located at a high curvature region of the fundamental mode or the selected higher order mode.

13. (Original) The cantilever of claim 11, wherein the first geometric feature is located at a high displacement region of the fundamental mode or the selected higher order mode.

14. (Original) The cantilever of claim 11, wherein the first geometric feature operates to alter the effective spring constant of the cantilever arm.

15. (Original) The cantilever of claim 11, wherein the first geometric feature comprises a mass removal region.

16. (Original) The cantilever of claim 15, wherein the first geometric feature operates to remove mass from a high curved region of the fundamental mode or the selected higher order mode to decrease the resonance frequency of the fundamental mode or the selected higher order mode.

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17. (Original) The cantilever of claim 15, wherein the first geometric feature operates to remove mass from a high displacement region of the fundamental mode or the selected higher order mode to increase the fundamental resonance frequency or the resonance frequency of the selected higher order mode.

18. (Original) The cantilever of claim 15, wherein the mass removal region comprises a first notch and a second notch formed at a first side and an opposite second side, respectively, of the cantilever arm.

19. (Original) The cantilever of claim 15, wherein the mass removal region comprises an opening formed in the body of the cantilever arm.

20. (Original) The cantilever of claim 19, wherein the mass removal region comprises a rectangular opening or a round opening.

21. (Original) The cantilever of claim 19, wherein the selected mode is the third flexural mode of the cantilever and the mass removal region is positioned at a high curvature region of the third flexural mode.

22. (Original) The cantilever of claim 21, wherein the mass removal region is positioned at one-third of the total length away from the free end of the cantilever arm.

23. (Original) The cantilever of claim 11, wherein the first geometric feature comprises a mass addition region.

24. The cantilever of claim 23, wherein the mass addition region increases the effective width of the cantilever at the predefined location.

25. (Original) The cantilever of claim 23, wherein the mass addition region increases the thickness of the cantilever at the predefined location.

26. (Original) The cantilever of claim 23, wherein the first geometric feature operates to add mass to a high curved region of the fundamental mode or the selected higher order mode to increase the resonance frequency of the fundamental mode or the selected higher order mode.

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27. (Original) The cantilever of claim 23, wherein the first geometric feature operates to add mass to a high displacement region of the fundamental mode or the selected higher order mode to decrease the fundamental resonance frequency or the resonance frequency of the selected higher order mode.

28. (Original) The cantilever of claim 1, wherein the cantilever arm comprises a material selected from the group of silicon and silicon nitride.

29. (Original) The cantilever of claim 1, wherein the probe tip is coated with a material selected from the group of diamond coating material and diamond-like carbon coating material.

30. (Original) The cantilever of claim 11, wherein the cantilever arm comprises a rectangular shaped cantilever including the first geometric feature modifying the shape and the mass of the cantilever arm.

31. (Original) The cantilever of claim 11, wherein the cantilever arm comprises a V-shaped cantilever including the first geometric feature modifying the shape and the mass of the cantilever arm.

32. (Withdrawn) The cantilever of claim 1, wherein the cantilever arm further comprises a first electrode of an electrostatic actuator where a second electrode of the electrostatic actuator is formed outside the cantilever, the electrostatic actuator operating to alter the effective spring constant of the cantilever by applying an electric field between the first and second electrodes.

Claims 33-51: (Cancelled)

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